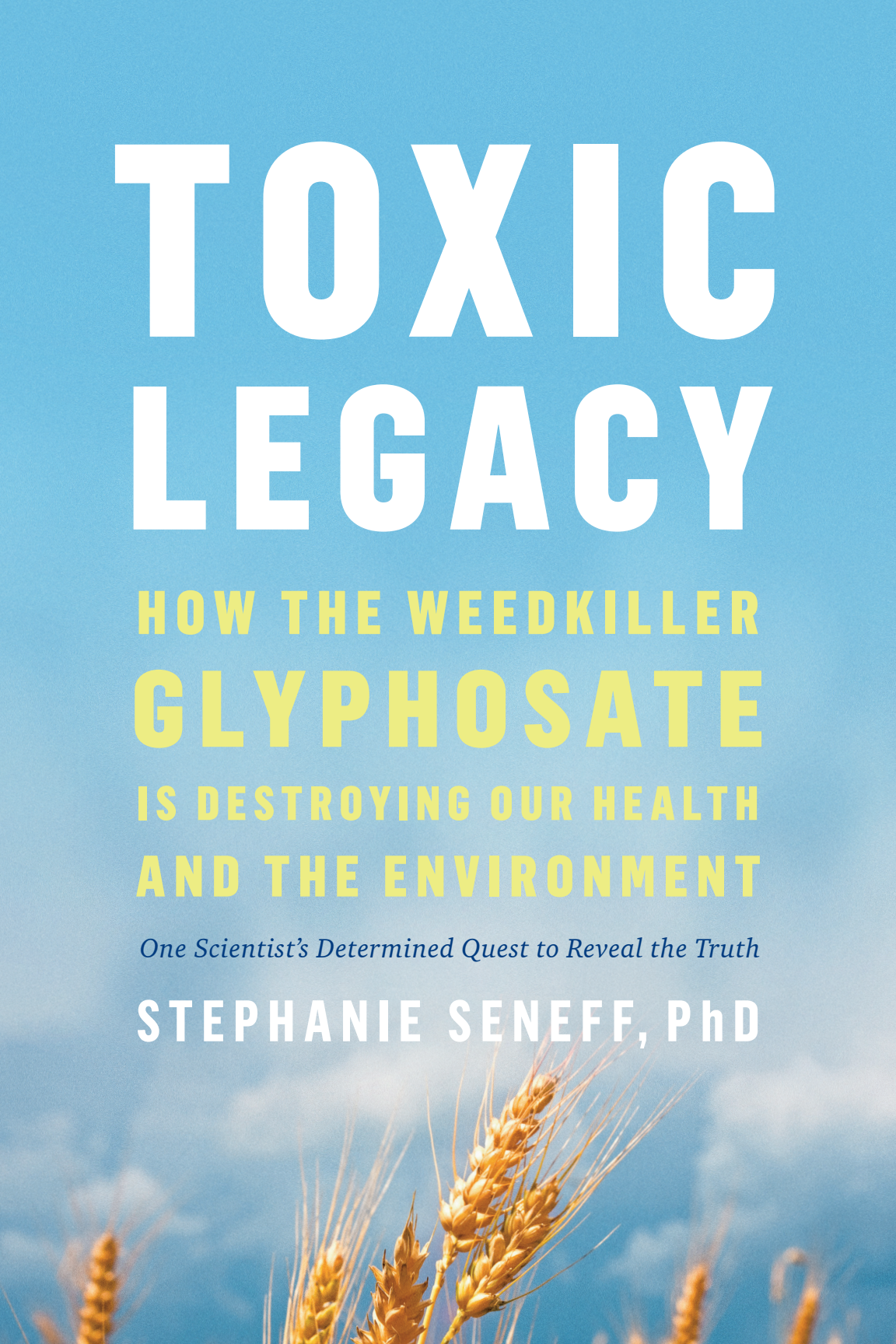
# TOXIC LEGACY

## HOW THE WEEDKILLER GLYPHOSATE IS DESTROYING OUR HEALTH AND THE ENVIRONMENT

*One Scientist's Determined Quest to Reveal the Truth*

STEPHANIE SENEFF, PhD



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STEPHANIE SENEFF, PhD

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— APPENDIX A —

# Tables

**Table A.1.** Twenty primary amino acids and their chemical properties.

| 1-Letter Code | 3-Letter Code | Name | Chemistry |
|---|---|---|---|
| A | Ala | Alanine | Hydrophobic |
| C | Cys | Cysteine | Polar |
| D | Asp | Aspartic Acid | Acidic |
| E | Glu | Glutamic Acid | Acidic |
| F | Phe | Phenylalanine | Hydrophobic |
| G | Gly | Glycine | Hydrophobic |
| H | His | Histidine | Polar |
| I | Ile | Isoleucine | Hydrophobic |
| K | Lys | Lysine | Basic |
| L | Leu | Leucine | Hydrophobic |
| M | Met | Methionine | Amphipathic |
| N | Asn | Asparagine | Polar |
| P | Pro | Proline | Hydrophobic |
| Q | Gln | Glutamine | Polar |
| R | Arg | Arginine | Basic |
| S | Ser | Serine | Polar |
| T | Thr | Threonine | Polar |
| V | Val | Valine | Hydrophobic |
| W | Trp | Tryptophan | Amphipathic |
| Y | Tyr | Tyrosine | Amphipathic |

**Table A.2.** Proteins involved with ATP binding that are upregulated in *E. coli* in response to glyphosate exposure.

| Protein | Fold Increase |
|---|---|
| putative ATP-binding component of a transport system | 2.02 |
| D,D-dipeptide permease system, ATP-binding component | 2.83 |
| ATP-binding protein of nickel transport system | 2.24 |
| ATP-binding component of transport system for glycine, betaine, and proline | 12.96 |
| fused D-allose transporter subunits of ABC superfamily: ATP-binding components | 2.03 |
| ATP-binding component of transport system for maltose | 2.38 |
| putative ATP-binding sugar transporter | 2.10 |
| putative ATP-binding component of a transport system | 3.04 |
| putative part of putative ATP-binding component of a transport system | 2.31 |
| putative ATP-binding component of a transport system | 2.30 |

*Note*: The number in the right column indicates the fold increase in protein expression. For details, see W. Lu et al. "Genome-Wide Transcriptional Responses of *Escherichia coli* to Glyphosate, a Potent Inhibitor of the Shikimate Pathway Enzyme 5-Enolpyruvylshikimate-3-Phosphate Synthase," *Molecular Biosystems* 9, no. 3 (2013): 522–30, https://doi.org/10.1039/c2mb25374g.

**Table A.3.** Nine proteins found to contain glyphosate substitutions that bind to phosphate-containing molecules.

| Sequence | Protein Name | Phosphate Binding |
|---|---|---|
| AIRQTSELTLG*K | zinc finger protein 624 | DNA |
| DG*QDRPLTKINSVK | pleckstrin homology domain-containing family A member 5 | PtdIns† phosphate |
| EPVASLEQEEQG*K | double homeobox protein A | DNA |
| G*ELVMQYK | diacylglycerol kinase gamma | ATP |
| GKELSG*LG*SALK | very long-chain specific acyl-CoA dehydrogenase mitochondrial | FAD |
| KDGLG*GDK | G-protein coupled receptor 158 | GTP |
| NEKYLG*FGTPSNLGK | ATP-dependent Clp, protease ATP-binding subunit | ATP |
| RTVCAKSIFELWG *HGQSPEELYSSLK | RNA (guanine(10)-N2)-methyltransferase homolog | tRNA |
| VTG*QLSVINSK | protein O-mannosyl-transferase 2 | dolichyl phosphate |

*Note*: G* indicates a glyphosate substitution in the peptide sequence.
† PtdIns = phosphatidyl inositol

**Table A.4.** Important proteins that bind heparan sulfate as a crucial part of their signaling mechanisms and to facilitate cellular clearance of debris.

| | **Protein** | **Biological Role** |
|---|---|---|
| **1** | antithrombin | systemic anticoagulation |
| **2** | t-plasminogen activator | clot dissolution |
| **3** | fibroblast growth factor | stimulate mitosis (cell division) |
| **4** | interleukins and selectins | inflammation |
| **5** | ApoE | lipoprotein clearance |
| **6** | fibronectin | cell adhesion |
| **7** | laminin | cell adhesion |
| **8** | type V collagen | cell adhesion |
| **9** | thrombospondin | cell adhesion, growth |

*Source*: Adapted from Table 29.1 in J. D. Esko, "Glycosaminoglycan-Binding Proteins," in *Essentials of Glycobiology*, eds. A. Varki et al. (Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press, 1999).

— APPENDIX B —

# Recommended Resources

**Organizations and Conferences**

Weston A. Price Foundation (www.westonaprice.org): A nonprofit organization that promotes eating traditional, nutrient-dense foods. Weston A. Price Foundation publishes an informative quarterly magazine, hosts an annual conference, and raises awareness about the harmful effects of toxins and toxic chemicals in the food chain.

The Institute for Functional Medicine (www.ifm.org): Functional medicine addresses the root causes of diseases; and functional medical practitioners seek to heal the whole person, not just prescribe a certain medicine for a specific illness. Medical doctors who practice functional medicine are often at the cutting edge of scientific innovation, helping patients be active in improving their health.

Sustainable Agriculture Conference (www.carolinafarmstewards.org/sac): A farmer-driven membership-based nonprofit that has hosted an annual conference for over 35 years, the Carolina Farm Stewardship Association offers both practical and philosophical training for anyone interested in family farming, local agriculture, and organic food practices.

Moms Across America (www.momsacrossamerica.com): An activist organization founded by Zen Honeycutt, a mother of three, to educate and empower moms about healthy eating and healthy communities. Their website is a treasure trove of helpful information about glyphosate, detoxification, and how to become active in the movement to fix our food.

EcoFarm Conference (eco-farm.org): An annual conference sponsored by EcoFarm, an ecological farming association whose mission is to nurture safe, healthy, just, and ecologically sustainable food systems. This wonderful nonprofit, founded in 1981 and still going strong, builds alliances, fosters community events, and celebrates healthy eating and a healthy planet.

The Public Interest Network (publicinterestnetwork.org): A social change organization that has launched a campaign to ban glyphosate, The Public Interest

Network is a nationwide organization that strives to make our planet's air, food, and water safer.

Toxic-Free Future (toxicfreefuture.org): This science-forward nonprofit champions using safer products, chemicals, and practices in order to better the health of humans and the planet. Their website includes helpful basic information and scientific articles about 21 chemicals of concern.

Children's Health Defense (https://childrenshealthdefense.org): Founded by environmentalist and health advocate Robert F. Kennedy Jr., Children's Health Defense is on the forefront of the movement to protect children from toxic exposures. They champion vaccine safety, medical freedom, and government transparency.

AutismOne (www.autismone.org): This parent-centered nonprofit gives support to families affected by autism. Their annual conference includes medical doctors, researchers, and health practitioners on the cutting edge of treatment for the prevention of and recovery from autism.

Environmental Working Group (www.ewg.org): This is one of my favorite organizations. This nonprofit empowers consumers to live longer, healthier lives by sharing research and education to drive better consumer choices and nonpartisan civic action. Their motto is that everything is connected (human health and the environment), and their website contains a wealth of information about everything from contaminants in drinking water to biopersistent forever chemicals in the environment.

International Society for Environmentally Acquired Illness (iseai.org): This international nonprofit medical society raises awareness of the environmental causes of chronic diseases and seeks to help patients recover their health. You don't have to be a doctor to join, and their One People, One Health, One Planet conferences are very informative.

Environmental Health Symposium (www.environmentalhealthsymposium.com): An annual conference geared toward physicians, which is also open to the public, that highlights how environmental toxins, including pesticides, herbicides, EMFs, and GMO technology affect human health.

NutriGenic Research Institute (www.nutrigeneticresearch.org): An institute that researches nutrition and studies how the environment interfaces with epigenetics, as well as what role epigenetic factors play in human health. Their website is a good place to learn about DNA testing, mitochondrial disorders, and how single nucleotide polymorphisms may affect your health.

Organic Consumers Association (www.organicconsumers.org/usa): A grassroots nonprofit public interest group, OCA works to protect and advocate for consumers' rights to safe and healthy food. They support regenerative agriculture, corporate accountability, and organic and family farming. You can find helpful

information about local farmers and where to purchase organic food on their website. They also run public interest campaigns and boycotts.

### Suggestions for Further Reading

Gabe Brown, *Dirt to Soil, One Family's Journey into Regenerative Agriculture*, 2018.

Rachel Carson, *Silent Spring*, 1962.

F. William Engdahl, *Seeds of Destruction: The Hidden Agenda of Genetic Manipulation*, 2007.

Carey Gillam, *Whitewash: The Story of a Weed Killer, Cancer, and the Corruption of Science*, 2019.

Carey Gillam, *The Monsanto Papers: Deadly Secrets, Corporate Corruption, and One Man's Search for Justice*, 2021.

R. D. Lee, *Gut-Brain Secrets, Part 1: Good Food, Bad Food: (Nutrition and Toxins in Food + GMO's and Glyphosate)*, 2018.

David Perlmutter, MD, *Grain Brain: The Surprising Truth about Wheat, Carbs, and Sugar—Your Brain's Silent Killers*, 2018.

Josh Tickell, *Kiss the Ground: How the Food You Eat Can Reverse Climate Change, Heal Your Body & Ultimately Save Our World*, 2017.

E. G. Vallianatos, *Poison Spring: The Secret History of Pollution and the EPA*, 2014.

Frank A. von Hippel, *The Chemical Age: How Chemists Fought Famine and Disease, Killed Millions, and Changed Our Relationship with the Earth*, 2020.

# Notes

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### Chapter 4: Amino Acid Analogue

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### Chapter 5: The Phosphate Puzzle

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